REVIEW OF FISH CONSUMPTION INFORMATION RELEVANT TO DEVELOPMENT OF IDAHO AWQC, LON KISSINGER 5/8/12, DRAFT

1. INTRODUCTION

EPA's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)* (Human Health Methodology) gives states and authorized tribes flexibility to provide scientifically valid options for developing their own ambient water quality criteria (HH-AWQC) that include consideration of local data, data reflecting similar geography/population groups, data from national surveys, and/or EPA's default intake rates (including a subsistence rate of 142 g/day).

2. PURPOSE

The purpose of this paper is to summarize EPA's preliminary review of fish and shellfish consumption information that should be considered in developing HH-AWQC with regards to use of local information and use of fish consumption data from similar populations and groups (i.e. items 1 and 2 from EPA's fish consumption data preference hierarchy noted above.)

Specific objectives to be covered include:

1) To review the attributes of fish and shellfish consumption surveys that make them appropriate for derivation of ambient water quality criteria generally and for Idaho in particular.
2) To review fish consumption information from Idaho, eastern Washington, and eastern Oregon that may be of relevance to deriving fish consumption rates for setting water quality standards in Idaho.
3) To discuss fish and shellfish consumption and harvest data from elsewhere in the Region 10 states (i.e. Puget Sound and Alaska) in the context of identifying similarities in fish consumption amongst different fish and shellfish consuming populations and their relevance to Idaho.

3. DESIRABLE ATTRIBUTES OF FISH CONSUMPTION SURVEYS FOR SETTING AMBIENT WATER QUALITY CRITERIA

The following is a list of attributes of a fish and shellfish consumption survey appropriate for derivation of a fish consumption rate to be used in developing ambient water quality criteria:

1. Development of a technical oversight panel to guide survey development and implementation including members of the surveyed group, representatives from federal and state environmental and public health agencies, and members of academia or the private sector with specific skills needed to conduct a survey.
2. Eliciting cooperation and input from the surveyed populations in designing surveys
3. Training of interviewers in survey techniques
4. Use of interviewers that are non-threatening to the population of interest.
5. Pilot testing of the survey instrument to determine its effectiveness in obtaining data from the target population and revision of the survey instrument in response to pilot testing.
6. Selection of a survey sample representative of the population of interest.

7. Use of sample size sufficient to support development of fish consumption rate statistics needed for AWQC derivation (e.g. average, median, and upper percentiles).
8. Accounting for geographic extent and seasonal variation in fish consumption activity and the availability of different species.
9. Use of portion models or photographs to assist in quantifying fish consumption
10. Recording consumption of all fish preparations (e.g. stews, smoked/canned/dried fish, etc.)
11. Recording the consumption of fish parts.
12. Recording the source of fish (e.g. stores, restaurants, harvested).
13. Specification and implementation of procedures for controlling data quality.
14. Clear identification of data analysis procedures (e.g. weighting of results, treatment of outliers, computation of percentiles)
15. Clearly documenting the survey methodology used.
16. Identifying sources of variability and uncertainty and to the degree possible, quantifying the impact of these sources.
17. Discussion of potential suppression effects (e.g. issues that may be present that lead to lower fish consumption than expected, for example the presence of environmental contamination, habitat destruction, changes in social structure of families affecting harvest, etc.)
18. Peer review of the report describing the survey and survey results.
19. Publication of the results of the survey.

4. FISH CONSUMPTION DATA FROM IDAHO, EASTERN WASHINGTON, AND EASTERN OREGON THAT ARE RELEVANT TO DERIVING FISH CONSUMPTION RATES FOR SETTING WATER QUALITY STANDARDS IN IDAHO.

EPA reviewed a number of fish consumption data sources from Idaho and parts of Oregon and Washington in close proximity to Idaho that are relevant in developing fish consumption rates for developing AWQC.

These information sources include:

A. CRITFC. 1994. A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin.
B. ATSDR. 1989. The Relationship of Human Levels of Lead and Cadmium to the Consumption of Fish Caught in and Around Lake Coeur D'Alene, Idaho
C. WA Dept. of Health. 1997. Consumption Patterns of Anglers Who Frequently Fish Lake Roosevelt
D. Ridolfi. 2007. Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, Richland WA.
E. Spokane Regional Health District. 1998. 1998 Fish Consumption Survey Spokane River, Washington
F. Confederated Tribes of the Umatilla Indian Reservation. 2004. Exposure Scenario for CTUIR Traditional Subsistence Lifeways.

To summarize the results of this review, EPA finds the CRITFC (1994) study to be of greatest relevance to development of Idaho AWQC because part of the target population of the CRITFC

survey, the Nez Perce Tribe, resides in Idaho and because the survey methodology employed by CRITFC meet many of the desired properties of a survey suitable for deriving a fish consumption rate to support AWQC development. The remaining information sources reviewed have methodological issues that make them less than ideal for deriving a fish consumption rate to support AWQC development. However, despite methodological issues and uncertainties, the remaining information sources taken together suggest that the federal default rate of 17.5 grams per day used by Idaho for development of AWQC may not be protective of Idaho fish consumers.

4.1. CRITFC 1994

The CRITFC survey instrument meets many of the criteria of a survey appropriate for deriving a fish consumption rate to support AWQC development. The survey employed a broad technical advisory panel with members from state/federal environmental and public health agencies, tribes, and academia. The tribes included in the CRITFC survey participated in survey development. Interviewers were trained in survey techniques. Using tribal members to interview tribal members was anticipated to produce an interview environment more conducive to obtaining accurate and complete results. The survey was pilot tested and the survey modified on the basis of pilot testing results. The survey sample was randomly selected from Indian Health Service files and is expected to be representative of the target population. The survey was designed to capture fish consumption throughout the year and to capture the geographic scope of fish harvest and consumption. Models were used to assist in quantifying portion size. The survey recorded different fish preparation methods and parts of fish consumed. Sources of fish were recorded. The survey asked questions about changes in fish consumption over time which could be useful in evaluating suppression effects. The survey utilized professional statisticians for data analysis. The results of the survey were published. Published results discussed survey methodology, data quality approaches, and data analysis methodology. Additionally the report discussed variability and uncertainties associated with the survey. The report was peer reviewed.

Currently, the data from the CRITFC report are not available for any further analysis. The fish consumption rates used for regulatory purposes include consumption of anadromous and resident fish from all sources (e.g. harvested, restaurants, and grocery stores). Further the consumption rates represent consumption by all of the tribes in the CRITFC survey. Nez Perce data were not available to compute rates for this tribe only.

The CRITFC report identified a number of uncertainties that might be considered in using survey results. The survey was conducted in November, a month of low fish consumption. This could lead to an underestimate of fish consumption. Most interviews were conducted at a central location, and the survey noted that the probability of being interviewed declined as a function of distance from the interview site. It is possible that elderly individuals practicing traditional life ways and consuming larger quantities of fish might have been less willing to travel, thus leading to their under representation in the final sample.

It should be noted that the CRITFC survey is now eighteen years old, and that its currency may be of concern.

CRITFC fish consumption statistics that may be of use in deriving AWQC are as follows:

Table 1: CRITFC (1994) Consumption Rate Statistics[1]					
Mean	**Median**	**75th**	**90th**	**95th**	**99th**
63	40	60	113	176	389

4.2. Additional Information on Fish Consumption Relevant to Idaho AWQC Development

This section discusses additional fish consumption information that is relevant to Idaho.

The Confederated Tribe of the Umatilla Indian Reservation 2004 analysis is not a fish consumption survey, but rather derives a Native American fish consumption rate based on an analysis of Native American fish consumption rates at the period of a tribal treaty with the U.S. government in 1855, assumptions about the fraction of the diet consisting of fish, total caloric intake, and the caloric value of fish. No interviews with current tribal members were provided to support the fish consumption rate advocated of 620 grams per day. The rate proposed is higher than those identified in other regional fish consumption surveys (Toy et al. 1996, CRITFC 1994) but is consistent with consumption rates derived for the Suquamish Tribe (Suquamish 2001) and fish harvest rates of native Alaskans (IDM 1997). The report contains no estimates of variability or uncertainty in fish consumption, and the degree of protectiveness afforded by using this rate in a regulatory context cannot be evaluated.

The remaining surveys reviewed were designed for purposes other than establishing accurate estimates of fish consumption. The purpose of each of these surveys is noted in Appendix A, which accompanies this document and summarizes and analyzes each survey. In many cases (ATSDR 1989, WA DOH 1997, Ridolfi 2007) surveys were designed to overestimate fish consumption in order to make decisions protective of public health. Consequently, all of the remaining surveys have methodological concerns with regards to establishing representative fish consumption rates that might be of relevance to developing Idaho's water quality standards. These concerns include:

1) Selection of survey sample populations in a non-representative way such that consumption rates are likely overestimated (ATSDR 1989 partially, WA DOH 1997, Ridolfi 2007).
2) Administration of the survey during peak fishing times and not throughout the year, potentially leading to overestimates of consumption (ATSDR 1989, WA DOH 1997)

[1] Values compiled from Table 10 "Number of Grams per Day Consumed by Adult Fish Cosnumers" of the Columbia River Intertribal Fish Commission Study (CRITFC 1994). 75th, 90th, and 95th percentiles were derived by linear interpolation between the bracketing percentiles. Values describe consumption of resident and anadromous fish from all sources.

3) Small sample size (Ridolfi 2007).
4) Failure to use portion size models to extrapolate from available information (e.g. fish consumed per year, fish meals per month) to grams of fish consumed per day, thus leading to substantial uncertainty in computing fish consumption rates (ATSDR 1989, WA DOH 1997, SRHD 1998). In particular, the assumptions to derive consumption rates from the Spokane River survey (SRHD 1998) imparted a high degree of uncertainty.

Assumptions were required to convert available information (e.g. fish meals per year, fish meals per week) to fish consumption rates in grams per day. These assumptions impart considerable uncertainty to the analysis process. The analysis approaches used and a more detailed review of these studies are provided in (Appendix A), however the fish consumption rate estimates derived are presented in Table 2. Statistics derived for these surveys include average and 95th percentile consumption rates for fish consumers only.

Of the populations surveyed, only the ATSDR 1989 study evaluated fish consumption of Idaho residents.

The results of this analysis indicate that mean and 95th percentile consumption rates are almost all uniformly greater than the fish consumption rate of 17.5 grams per day used by Idaho in their AWQC development. Though methodological issues and assumptions impart uncertainty to this analysis, the studies taken together suggest that 17.5 grams per day may not be protective of fish consumers in Idaho.

Table 2: Fish Consumption Rates Derived from Fish Consumption Surveys Reviewed by EPA (Consumer only)					
Study	**Population**	**Sample Size**		**Fish Consumption Rate**	
		Total Surveyed	**Consumers**	**Average**	**95th percentile**
ATSDR 1989	Coeur d'Alene Tribal members	352	102	71	208
	Volunteers w high fish consumption	287	281	37	268
	Licensed anglers	167	154	26	339
WA DOH 1997	Anglers fishing Lake Roosevelt	348	Reporting eating fish from Lake Roosevelt, 193	17/22[2]	38/67
Spokane County Health District	Licensed anglers	627	Filled out survey portion needed to complete analysis, 70	99	498
Ridolfi 2007	Yakama Tribal Members	16	16	150	400

5. Additional Region 10 Fish Consumption Data and Implications for Fish Consumption Rates in Idaho

5.1. Puget Sound Personal Interview Fish Consumption Surveys

A number of fish consumption studies have been done in the Puget Sound region. These studies include evaluation of seafood consumption for the Tulalip Tribes and Squaxin Island Tribe (Toy et. al. 1996), the Suquamish Tribe (Suquamish 2000) and Asian and Pacific Islanders (U.S. EPA 1999). The designs for these surveys were based on CRITFC (1994). Consequently, they meet many of the criteria for well designed surveys suited to AWQC development and environmental regulation. In particular, both the States of Oregon and Washington have recognized the quality of these surveys for purposes of environmental regulation (ODEQ 2008, Ecology 2011).

[2] Value before "/" represents consumption assuming a 6 ounce meal size. Value after "/" represents an 8 ounce meal size.

Table 3: Adult fish consumption rates (grams per day) recommended by the human health focus group for Oregon human health-based water quality criteria (taken from ODEQ 2008)

Group	Species included in consumption rate evaluation	N	Statistic					
			Mean	Median	Percentile			
					75th	90th	95th	99th
Tulalip Tribe	Anadromous and estuarine finfish and shellfish	73	72	45	85	186	244	312
Suquamish Tribe	Anadromous and estuarine finfish and shellfish	284	214	132	NA	489	NA	NA
Squaxin Island Tribe	Anadromous and estuarine finfish and shellfish	117	73	43	NA	193	247	NA
Columbia River Tribes	Freshwater and anadromous finfish	512	63	40	60	113	176	389
Asians & Pacific Islanders	Anadromous and estuarine finfish and shellfish	202	117	78	139	236	306	NA

N = Number of adults in survey NA= Statistical value not available. Adults are 18 years or older for all surveys except Suquamish; Suquamish adults were 16 years or older All values reported in this table are described in Table 1 (located at the end of this document) Tulalip Tribes and Squaxin Island Tribe from Toy *et al.* 1996. Suquamish Tribe from Suquamish. 2000. Columbia River Treaty Tribes from CRITFC. 1994. The Columbia River Tribes did not report marine fish consumption; The 75, 90, 95 and, 99th percentiles are interpolated from percentiles reported in CRITFC 1994 Asian Pacific Islanders from Sechena *et al.* 1999. US General Population from US EPA. 2002.

5.2. Recreational Angler Surveys

Most of the available surveys of recreational angler fish consumption were done in the 1980s and 1990s for Puget Sound (Landolt et al. 1985, Pierce et al. 1981, McCallum 1985) and the Columbia Slough near Portland on the Columbia River (Adolfson 1995). The most recent study of recreational fish consumption in King County, the county within which Seattle is located, was done in 2007 (Mayfield et al. 2007). These surveys were creel surveys, where interviewers encountered anglers in the field and inquired about their catch. There are a number of methodological issues with creel surveys that reduce their utility for regulatory purposes. These issue include: difficulties in eliciting year-round consumption information; difficulties in using visual aids or other materials to assist in quantifying consumption; inability to obtain a random, unbiased sample of the study population; the willingness of the interviewee to provide information in a field situation when the interviewee would rather be angling; concerns about accurate transmission of fishing information due to trust issues (e.g. the interviewer might be perceived as an outsider or there may be concerns about the interviewer having connections with fishing regulation enforcement); language and communication issues if anglers do not speak English; adequately measuring fish consumption over the geographic area of concern; adequately assessing fishing activity at all times when fishing might occur; underestimation of catch associated with measuring catch prior to the end of fishing activity; and problems in relating an angler's catch to consumption rates of the angler's family and community. Creel surveys of Tribes typically are not conducted by Tribal members, which could decrease the

comfort of interviewees and the probability of complete and accurate transmission of information.

There were also specific issues associated with several of the surveys. Landolt et al. (1985) didn't interview shore anglers at the end of their fishing trips potentially underestimating consumption. Measurement of shellfish intake in Landolt et al. (1985) was limited to crab. Pierce et al. (1981) did not include salmon in assessing consumption. All of the studies assessed fish consumption from areas known to have environmental contamination. In particular Columbia Slough is posted with signs warning individuals about consuming fish from the area (Adolfson 1995). Fears of environmental contamination could lead to suppressed estimates of consumption from these recreational surveys, leading to lower fish consumption rates. Use of suppressed consumption rates to set AWQC could lead to AWQC that do not support restoration of water bodies to their best use.

The Mayfield et al. (2007) consists of three separate surveys of angler efforts in Elliott Bay near Seattle, north King County and King County Lakes. The Elliott Bay survey was conducted over 10 weeks during peak summer fishing activity. A substantial number of individuals refused to have their catch weighed and/or refused to be interviewed. Mayfield et al. (2007) also does not address how language issues were dealt with in administering the survey to non-English speakers.

Given the issues associated with creel surveys, it is recommended that recreational angler rates be considered in a supporting or weight of evidence role when evaluating fish consumption in Idaho

Table 4: Fish Consumption Rates from Pacific Northwest Recreational Angler Creel Surveys Conducted Prior to 2000 (all rates in grams per day)

Authors (date)	50th Percentile	90th Percentile	95th Percentile	Mean
Pierce et al. (1981) (USEPA 1997 estimates)	19	155	na	na
Landolt et al. 1985 shore anglers (adapted from U.S. EPA 1988)	31	176	277	61
Landolt et al. 1987 boat anglers (adapted from U.S. EPA 1988)	12.3		95.1	
McCallum (1985) (adapted from U.S. EPA 1988)	1.9	na	24.3	na
Adolfson (1996)	~24	na	na	na

Table 5: Consumption Rates for King County Recreational Anglers (Mayfield et al. 2007)					
Location	N	50th Percentile	90th Percentile	95th Percentile	Mean
Marine fish Consumption					
Duwamish River	50	2	23	42	8
Elliott Bay	377	31	145	221	63
North King County	67	17	85	102	32
All Locations	494	21	121	181	53
Shellfish Consumption					
Duwamish River	16	4	77	123	20
Elliott Bay	49	14	74	119	28
North King County	31	12	62	132	22
All Locations	96	11	60	119	25
Freshwater fish consumption from King County Lakes	128		Na	23	42

5.3. Alaska Data

In contrast to data from other Region 10 states, Alaska has recorded harvest data as opposed to consumption data. It would be expected that harvest rates would be lower than consumption rates, as some harvest could potentially be sold or utilized for other purposes (e.g. feeding sled dogs). IDM (1997) attempted to categorize harvest rates in different ecological zones of Alaska but met with limited success, as resource use was found to be quite variable within eco regions.

Given that the Alaska data are harvest rates rather than consumption rates and that the authors of the IDM survey noted high variability in harvest rates and that Alaska's populations may exhibit significantly different consumption patterns than resident of Idaho, it is recommended that these data be considered in a supporting or weight of evidence role when evaluating fish consumption in Idaho.

Table 6: Regional harvest rates of Alaskan fisheries resources based on best fit distributions, g/day (IDM 1997)					
Region	**Resource**	**50%**	**90%**	**95%**	**Max**
Arctic-Subarctic	Salmon	193.8	437.8	525.7	834.6
	Non-salmon fish	63.6	262.8	361.3	830.1
	Marine invertebrates	1.3	8.1	12.3	28.9
Aleutian-Pacific	Salmon	118.1	210.5	235.1	397.3
	Non-salmon fish	58.8	106.9	120.4	276.6
	Marine invertebrates	17.2	32.4	38	56.3
Subarctic Interior	Salmon	76.8	542.9	987.9	1988.4
	Non-salmon fish	27.8	112.7	149.6	445.4
	Marine invertebrates	0.8	1.9	2.2	5.6
SE AK Coast	Salmon	61.3	127.8	151.9	216.6
	Non-salmon fish	57.1	115.8	136.1	217.5
	Marine invertebrates	33	68.6	84.8	144.8
Urban	Salmon	32.4	54.4	60.4	82.6
	Non-salmon fish	17	25.7	28.5	37.4
	Marine invertebrates	3	12.1	16	20.8

5.4. Discussion

Puget Sound personal interview data provided in Table 3 suggest similarities amongst several fish consuming populations. Average consumption rates for the Tulalip Tribes, Squaxin Island Tribe and Asian Pacific Islanders were approximately in the 75 to 120 g/day range while 95th percentile consumption rates were in the 250 to 300 g/day range. The Suquamish Tribe has much higher consumption rates than these other groups average 214 g/day and 90th percentile of 489 g/day. The difference between the Suquamish Tribe and other groups may be related to the fish and shellfish resources available to the Suquamish relative to other groups. Alaska harvest data provided in Table 6 suggest a somewhat similar division in harvest rates. Fisheries resource harvest in more urban areas is much lower than harvest from wilderness areas. CRITFC (1994) consumption rates are slightly lower than those found in Puget Sound personal interview surveys. This may be related to differences in fisheries resources available to Columbia River tribes relative to Puget Sound fish consuming populations. Recreational angler creel survey fish consumption data provided in Tables 4 and 5 are not as consistent as the Puget Sound personal interview survey data. As noted previously, methodological issues make creel surveys less than ideal for purposes of environmental regulation. However, some recreational angler surveys, including the most recent analyses conducted by Mayfield et al. 2007, indicate that recreational anglers may consume seafood at rates similar to Puget Sound tribal and ethnic populations.

6. Conclusions

The CRITFC (1994) survey is suitable for derivation of a fish consumption rate to support AWQC development, indicates that fish consumption in the State of Idaho could exceed 17.5 g/day, and indicates that AWQC derived using a fish consumption rate of 17.5 g/day may result in AWQC that are not protective of Idaho fish consumers. This conclusion is supported by consideration of additional information from Idaho, eastern Washington and Oregon. This additional information is not of the same quality as the CRITFC (1994) survey and is not ideal for developing a fish consumption rate for AWQC. However, the information suggests that fish consuming populations in Idaho consume more than 17.5 grams per day. Personal interview survey fish consumption data from Puget Sound and harvest data from Alaska suggest that different fish consuming populations have similar levels of fish consumption and that CRITFC consumption rates are not unduly high. Despite methodological issues, older Puget Sound creel survey data suggest that recreational anglers have the potential to consume fish at rates observed for Puget Sound tribal and ethnic populations.

Taken together, these various lines of evidence strongly suggest that a range of Idaho fish consuming populations may consume fish at rates in excess of 17.5 grams per day, and that Idaho AWQC based on a fish consumption rate of 17.5 grams per day may not be protective of Idaho fish consumers.

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Study, Synopsis, Survey Type	Populations, Sample Size, Relevance	Statistic		Design Factor Impact on Consumption Rates				Analysis and Assumptions
		Type	G/day	Imparting Positive Bias	Imparting Negative Bias	Contributing to Uncertainty	Contributing to Accuracy and/or Representativeness	
<u>Study</u>: ATSDR. 1989. The Relationship of Human Levels of Lead and Cadmium to the Consumption of Fish Caught in and Around Lake Coer D'Alene, Idaho. <u>Synopsis</u>: Surveyed fish consumption rates over the two months prior to the interview period for fish consuming populations potentially exposed to cadmium and lead from consumption of fish in the Lake Coeur d'Alene area. Characterized factors affecting lead and cadmium levels in study participants. Measured lead and cadmium in study participants. Phase I of the study was the fish consumption survey and is of the greatest interest <u>Survey Type:</u> Personal interview, telephone or face to face	<u>Population 1:</u> Coeur d'Alene Tribal Members, <u>Sample size:</u> Total, N = 352 Consumers, N = 102 <u>Relevance:</u> Sample representative of an Idaho population	Mean	71	• Study conducted for a short period of time during peak fishing season likely contributing to an overestimation of annual rates. • Meals containing fish treated as consumption of whole fish. • Self selection of volunteer participants likely to be high fish consumers	• Children and adults surveyed together • Lake Coeur d'Alene is known to have environmental contamination.	• Only head of household interviewed • Children and adults surveyed together • Number of meals per month categories were broad • Models not used to quantify portion sizes. Question referred to 8" fish consumed. • No mention of pilot testing • TRUE FOR TRIBAL RESULTS ONLY: Less accurate results possible because of use of non-tribal interviewers • Data quality and analysis not well characterized	• Random selection of participants from total list of tribal members living near Lake Couer d'Alene • Random selection of participants from licensed fishing holders • Tribal members interviewed at home contributing to inclusion of tribal elders • Interviewers trained.	The same analysis approach was applied to the three populations examined in this study (i.e. Couer d'Alene Tribal members, volunteers, and licensed anglers) Grams per day = meals per week x (% adults x % males x meal size + % adults x % females x meal size + % children x meal size) x week / 7 days Grams per day values were computed for participants for each meals per week consumption group. Cumulative percent and grams per day values were then computed for each meals per week class. Linear interpolation was used to derive 95th percentile from percentiles bracketing the 95th percentile. Assumed: • Fraction of children and gender differences are constant across meal per week consumption classes. • Rates are consumer only • Mid point of meals per month and portion size utilized for estimate
		95th %	208					
	<u>Population 2:</u> Volunteers with high fish consumption, <u>Sample Size:</u> Total, N = 287 Consumers, N = 281 <u>Relevance:</u> Sample representative of an Idaho population	Mean	37					
		95th %	286					
	<u>Population 3:</u> Licensed anglers, <u>Sample Size:</u> Total, N = 167 Consumers, N = 154 <u>Relevance:</u> Sample representative of an Idaho population	Mean	26					
		95th %	339					
<u>Study:</u> EPA. 1997. Lake Couer d'Alene Superfund site human health risk assessment, (HHRA) **<u>Synopsis:</u>** The risk assessment used the 1989 Lake Couer d'Alene study described above to characterize fish consumption for the HHRA. Based on the study, EPA developed a consumption rate of 1 meal per week as representing approximately 95% of the population	See above	46, SEE analysis assumptions		See above	See above	See above	See above	Grams per day = one meal per week x 326 g per meal/7 days per week

Study, Synopsis, Survey Type	Populations, Sample Size, Relevance	Statistic		Design Factor Impact on Consumption Rates				Analysis and Assumptions
		Type	G/day	Imparting Positive Bias	Imparting Negative Bias	Contributing to Uncertainty	Contributing to Accuracy and/or Representativeness	
Study: WA Dept. of Health. 1997. Consumption Patterns of Anglers Who Frequently Fish Lake Roosevelt **Synopsis:** Study designed to determine consumption patterns of Lake Roosevelt fish by boating anglers who repeatedly fish Lake Roosevelt in order to determine potential health impacts of exposure to contaminants in fish. **Study Type:** Creel (i.e. inspection of angler's catch in the field)	**Populations:** Anglers fishing Lake Roosevelt **Sample Size:** N = 348 N = 193 (Individuals reporting they eat fish from Lake Roosevelt) **Relevance:** The surveyed population is not from Idaho, but may be representative of Idaho populations	Mean, 8 oz portion size	22	• Non representative sample, high bias towards more frequent anglers • Only high fishing months surveyed. Missed months of January, February, March and April. Averaging in low fish consumption months would decrease consumption rates.	• Interviewees may not provide complete information if interviewers are perceived as authorities with regulatory power. • Lake Roosevelt known to have environmental contamination	• Field survey environment not conducive to accurate results. Interviewers noted anglers were anxious to leave after having completed fishing. • Portion size models not used. • Difficult to pilot test survey instrument with a creel survey if populations are variable. • Survey results only for anglers themselves. Consumption not estimated for household members • Not all known fishing locations were surveyed. A random sample of known fishing locations were surveyed. • Data quality and analysis not well characterized	• Survey was pilot tested. • Interviewers received training. • Use of tribal interviewers may have enhanced responses for tribal anglers, though only 2.4% of the anglers were Native American	Conversion of meal per year required an assumption about the amount of fish consumed per meal. 6 and 8 ounce portions were assumed. It is uncertain as to how accurate this is. The study authors specifically state that models need to be used to accurately characterize portion size. Table 2 from the report giving meals per year from the 1994 survey effort was utilized for this analysis. Grams per day = meals per year x oz per meal (either 6 or 8) x 28.35 grams per ounce / 365.5 days per year. Cumulative percent and grams per day values computed for each meals per year class. Linear interpolation used to derive 95th percentile from percentiles bracketing the 95th percentile.
		95th % 8 oz. portion size	67					
		Mean, 6 oz portion size	17					
		95th % 6 oz portion size	38					

Study, Synopsis, Survey Type	Populations, Sample Size, Relevance	Statistic		Design Factor Impact on Consumption Rates				Analysis and Assumptions
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Study: Spokane Regional Health District. 1998. 1998 Fish Consumption Survey Spokane River, Washington **Synopsis:** Study was designed to examine patterns of fish consumption to support assessment of contaminant risks **Study Type:** Mail survey	**Population 1:** Licensed Anglers **Population 1, sample size:** N = 627 N = 70 individuals who reported keeping fish **Population 2:** Walleye Club Sports Fishers **Population 2, sample size:** N = 56 **Relevance:** The surveyed population is not from Idaho, but may be representative of Idaho populations	Mean, pop 1 95th % Pop 1	99 498		Spokane River is known to have environmental contamination.	• Mail survey Interviewees don't have access to an interviewer to clarify questions. • Data quality and analysis not characterized	License holder sample was randomly selected	**MAJOR** assumptions were needed to convert from fish consumed per year to grams of fish per day. Assumptions included: • Rainbow Trout were the only species consumed. • The average rainbow trout weight is 6 pounds • The yield of fillet meat per fish was 0.7 Grams per day = fish meals per year x 6 pounds per fish x 453.6 grams per pound x 0.7 fillet yield per fish / 365.5 days per year Cumulative percent and grams per day values were computed for each meals per year class. Linear interpolation was used to derive 95th % from percentiles bracketing the 95th %.

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Study: Ridolfi. 2007. Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, Richland WA. **Synopsis:** Interviews of Yakama Tribal members were conducted to obtain information on how tribal members might be exposed to environmental contaminants at the Hanford Site. Part of the interview process characterized consumption of fish. **Study Type:** Personal Interview	**Populations:** Yakama Tribal Members **Sample Size:** N = 16 **Relevance:** The surveyed population is not from Idaho, but may be representative of Idaho populations	Mean 95th %	150 405	• Survey population included a larger number of tribal elders than was found in the general population • Children's rate development was based on respondents up to age 18, leading to a high bias to children's consumption rate estimates	The Hanford area is known to have environmental contamination	• A sample population of 16 is very small, and there is likely a high degree of uncertainty associated with any statistics. • The report seems to indicate that the interview process and interview questions may have changed over time. This could lead to lack of comparability and increased variability amongst interview responses.	• Models were used to characterize portion sizes, though detailed descriptions of the models used were not provided in the report. • Tribal members conducted interviews, potentially leading to more accurate responses. • Pilot testing and interview training are not specifically discussed, though it is noted that development of the survey instrument was an iterative process. This implies that some pilot testing and interview training was done.	A figure of fish consumption rates for the 16 interviewees was used to obtain consumption information for each interviewee. The 95th percentile was computed using Excel's percentile function.
Study: Confederated Tribes of the Umatilla Indian Reservation. 2004. Exposure Scenario for CTUIR Traditional Subsistence Lifeways. **Synopsis:** The report describes exposure scenarios unique to Native Americans and develop exposure parameters and values for exposure. An underlying assumption is that exposure should be quantified based on Native American lifestyles during the period before or at the time of the signing of the treaty of 1855. A consumption rate of 620 grams per day is advocated based on assumptions about total caloric intake, the percentage of caloric intake associated with fish consumption, and the caloric value of fish.	**Discussion** The rate proposed is higher than those identified in other regional fish consumption surveys (Toy et al. 1996, CRITFC 1994) but is consistent with consumption rates derived for the Suquamish Tribe (Suquamish 2000) and fish harvest rates of native Alaskans (IDM 1997). The report does not discuss any interviews with Yakama tribal members to support the proposed rate. The report contains no estimates of variability or uncertainty in fish consumption, and the degree of protectiveness afforded by using this rate in a regulatory context cannot be evaluated. The use of tribal treaty rights as the basis for exposure assessment and the development of AWQC is a legal and policy question that is outside the scope of this technical review.							